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AGRICULTURAL
Research

January/1962

THE FOOD GAP

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USDA Centennial

This is the centennial year of the United States Department of Agriculture, a year that will be widely noted by agricultural and related industries.

Much writing about this or any other centennial should and will be focused on growth and progress and on achievements and service of the past.

But, shouldn't we also contemplate the future—the challenges to agriculture in the next 100 years? For example, what is the challenge of our fast-increasing population?

In his first report to President Lincoln in 1862, Commissioner of Agriculture Isaac Newton wrote: "It is hard to realize that some who shall read these lines will live to see one-hundred millions of freemen dwelling in this dear land of ours."

Our population has already passed the 185 million mark, and continues to increase. U.S. population has multiplied six-fold since 1862. What will the population be in 2062? What will be the demand for food? Will we be able to produce enough? Will our diets be better?

It is also interesting to speculate about the number of people that one farmer will be able to feed in 2062. Today he feeds 25 people in addition to himself. Will he still be feeding 25 in 2062, or will it be 260 or even 2,600?

Research has paid off so well in the past in answering similar questions that we logically must look to it for answers to these and other questions of the future.

The USDA has already looked 50 years into the future. Long-range projections based on certain assumed relationships in the future have already given us rough approximations of expected changes in agriculture. The direction of change is clear—demands on agriculture will increase substantially.

But, prospects are that advances in technology can continue to keep pace with population demands.

Since the time of Franklin and Jefferson, the American people have had faith in the ability of research to yield both material and intellectual benefits. This same faith must prevail as agriculture faces the future.

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Growth Through Agricultural Progress

AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

THE FOOD GAP

“We must narrow the gap between abundance here at home and near starvation abroad. Humanity, and prudence alike, counsel a major effort on our part.”

John F. Kennedy, January 24, 1961

■ Two-thirds of the people in the world have nutritionally inadequate diets. Most of them live in 70 underdeveloped countries in semitropical and tropical areas. In these countries, per capita incomes are low, and ratios of population to land are high. Yields per acre are generally low, and little or no chemical fertilizer is used. There is no likelihood that these people will have enough food, or the right kinds of food, in the near future.

In sharp contrast, the remaining one-third of the people have diets that are up to or above minimum nutritional standards. Their food supplies for the future are assured, considering existing resources. These people live in 30 industrialized countries located mainly in the Northern Hemisphere. In most parts of these nations, people have permanently escaped from malnutrition and hunger. In some of these countries, this remarkable achievement has been realized only within the last two or three decades.

These facts come from a USDA study—the most comprehensive of its kind—of the world’s balance of food. The study was requested by Secretary of Agriculture Freeman to identify the world’s food needs, as a prerequisite to the “major effort” urged by the President.

We now know, according to W. W. Cochrane, USDA’s director of agricultural economics, the magnitude of the world’s needs for food—nutrient by nutrient, commodity by commodity, and country by country.

In the study, economists determined the amount of foods produced and consumed in the world in 1958. Using this information and minimum nutritional standards worked out for each country, they estimated the amount of food people in the underdeveloped countries would need for adequate diets this year and in 1966. The economists also estimated how much food will be available. Included in their calculations are projected production, imports, and food grants.

Large shortages will occur this year, and the situation will be about the same in 1966. For ease of understanding, the nutrients are expressed in terms of a few widely known commodities; many other products could be used to satisfy nutritional requirements.

In 1962, the underdeveloped countries will lack animal protein, leguminous protein, fat, and total calories in the following amounts, respectively: 3.3 billion pounds of nonfat dry milk; 3.5 million 100-pound bags of dry beans; 7.0 billion pounds of vegetable oil; and 1.1 billion bushels of wheat.

Turn Page

THE FOOD GAP

(Continued)

U.S. exports distributed in the Food for Peace program, which includes sales for foreign currency, barter, long-term dollar loans, and gifts, will increase in the 1962 fiscal year.

Total exports of wheat, for example, including those sent by Food for Peace, are expected to reach 675 million bushels, compared to 662 million in 1960-61. Exports of 1.9 billion pounds of vegetable oils and 740 million pounds of nonfat dry milk are also expected to be record high. Large exports of soybean proteins and dried beans are being considered to help offset the large deficit of protein.

Food for Peace exports are expected to gradually increase in the next 5 years. But, warns Cochrane, we cannot eliminate the world food deficit and surplus problems in the U.S. simply by further expanding Food for Peace shipments. His reasons: the magnitude of the deficit, the large cost to us, problems that would be created for other exporting countries, and limiting conditions in the food-deficit countries.

Some of these limiting conditions are insufficient physical facilities for receiving and distributing food, lack of income of the people to purchase food, and inability or unwillingness of the governments to operate countrywide free food distribution programs.

Changes in U.S. production believed one way to help supply needs

Cochrane feels, however, that the world's food needs and our ability to fill these needs would be better served if we produced less feed grains and more soybeans, dried beans, and peas. Soybean oil could be used to reduce the critical shortage of fats. And larger quantities of rice could be used for emergency shipments to certain countries.

While these Food for Peace exports can help alleviate food shortages in many areas, the world food deficit can be eliminated only by increased production of food and the things that can be traded for food in the underdeveloped countries themselves.

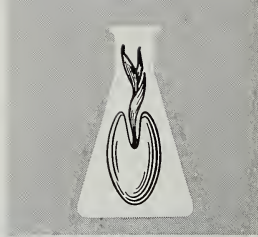
The industrialized areas in the Northern Hemisphere can make sure agricultural production keeps ahead of population growth in their countries by continuing investments in research and development. Such past investments helped them to reach their present level of agricultural and industrial progress.

More land needed for commercial farming in underdeveloped nations

In the underdeveloped countries, more economic development and increased urbanization and industrialization are needed to increase incomes and take people out of subsistence farming. This would allow increased agricultural production for commercial markets.

In some parts of Latin America, Africa, and West Asia, more land could be put to agricultural use.

Among the many immense needs of the underdeveloped countries to bring up their food production is increased use of chemical fertilizer. In the Far East and Communist Asia, huge investments are first necessary to build chemical fertilizer plants. And to ensure effective use of plant nutrients, much money must be invested in irrigation.☆



Outstanding research is one excellent reason for the U.S. being the world leader in agriculture. USDA and cooperating scientists have improved crops, livestock, methods, technology, equipment . . . improvements that have resulted in spectacular gains. Each month during this Centennial Year we are saluting researchers by pointing out some of their many accomplishments.

■ Automation . . . hogomatic . . . loose housing . . . electric brooding . . . hyperbolic paraboloid. These terms and many others contributed by agricultural engineering research have come into use in the 100 years since USDA was organized.

Agricultural engineering research, as an officially designated part of USDA's responsibilities, began about 1890. Since then, Department en-

Insect traps, developed by engineers and entomologists, aid survey and control.



First in a Centennial Series:

AGRICULTURAL ENGINEERING

Engineers have made significant contributions to the development of the most productive and efficient agriculture in the world.

Advances have meant more efficient production and less labor for farmers. Pushbutton farming is still more the exception than the rule—but more automation is on the way.

Many of these developments are the result of cooperative work by ARS engineers, other USDA scientists, and their colleagues at the land-grant colleges and in private industry. Some examples:

One of the earliest uses of electricity on the farm, other than for lighting buildings, was for electric chick brooders in the 1920's. Since then research has led to other developments such as highly complex, completely automatic, electric processing systems that grind, mix, and deliver feed to livestock and poultry.

In Illinois, ARS-State agricultural engineers designed an automatic system to house and feed 43,000 turkeys and broilers a year on one farm.

An ARS engineer aided in designing underground herbicide spray device.



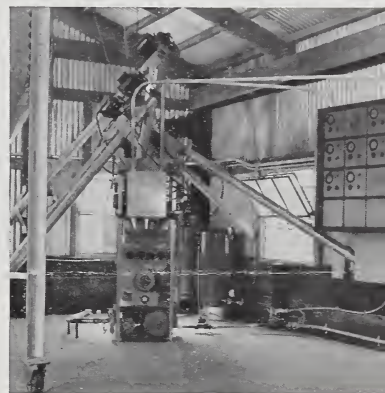
Spreading fertilizer was mostly guesswork a century ago. Today, farmers use engineer-designed, precision equipment that puts the right amount of fertilizer where it's needed.

Agricultural engineering research has eliminated much hand labor in the fruit industry. For example, two men can pick small fruits from 30 to 50 trees in an hour. In 1961, 25 percent of Michigan's blueberry crop was completely harvested by machines for the first time.

The cotton gin had been in use nearly 70 years when USDA was organized. Eli Whitney, inventor of the gin, would never recognize it today. And the ginning process has been expanded by engineers to include drying, cleaning, and packaging—nearly all automatically.

A century ago livestock were usually housed under one roof. Buildings now are specifically designed for dairy cows, beef cattle, sheep, swine, or poultry. Structures are lighted, ventilated, and designed for more efficient operation.☆

Strong new farm building roof, designed by ARS agricultural engineers, is being tested.



Fully automatic poultry feeding unit was engineer-developed.



Machinery that takes labor out of livestock feeding is only part of much equipment engineers developed in efforts to bring automation to agriculture.



COMBINATION GRAZING INCREASES EFFICIENCY

Better gains and use of forage may result if cattle and sheep, in a proper ratio, feed in the same pasture

■ On identical 10-acre, fertilized pastures in the East . . .

. . . Farmer *A* grazes 10 steers for 5 months.

. . . Farmer *B* grazes 50 sheep for 5 months.

. . . Farmer *C* grazes 5 steers and 25 sheep for 5 months.

Whose animals will produce the most meat? Whose pasture will be in the best condition at the end of the grazing period?

Farmer *C* should be ahead on both counts, according to preliminary results of a USDA study to determine if utilization of fertilized pastures can be increased by such combination grazing.

Researchers making the study aren't ready to make recommendations. The study has been in progress only one season, and will require several years to complete.

First-year results indicate, nevertheless, that sheep and cattle do better grazing together than when separated. Dual-grazed pastures also are ap-

parently in better condition after the first season of use than those grazed exclusively by sheep.

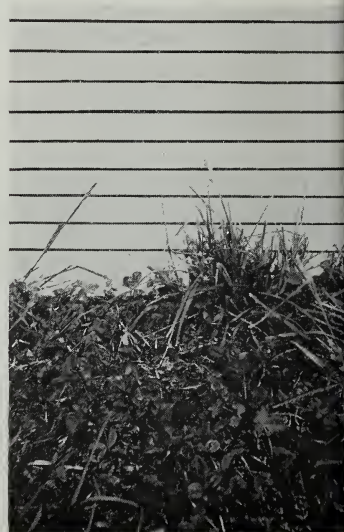
Five sheep were substituted for each steer in the pastures (as in farmer *C*'s pasture). But ARS animal husbandmen James Bond, I. L. Lindahl, and agronomists D. E. McCloud and C. W. Alexander say this ratio may not be best. In future tests, they hope to find an ideal ratio for the pastures being studied.

Does the stocking rate in the hypothetical examples—equivalent to one steer (animal unit) per acre—seem excessive? It isn't, according to results after one season of use. Pastures stocked at a minimum of 1½ animal units per acre from May through mid-October didn't appear damaged. (Even heavier stocking

rates were used in early spring.) All animals on these pastures made satisfactory gains. And Bond and Lindahl say livestock grazed together (at the 5 to 1 ratio) did better than sheep or cattle alone.

All the pastures were fertilized and had previously established good stands of orchardgrass and ladino clover. The studies are being made at Beltsville, Md.

Grass and clover (left) were in good shape in double-stocked pasture; with sheep only, clover production was low under tall, lightly grazed grass (right).



Other pastures in the experiment stocked at the rate of 2 animal units per acre during the summer season were damaged. But the least damage was in the combination-grazed pasture stocked at this high rate.

The researchers also tried stocking pastures with steers and sheep in equal numbers (like grazing 10 sheep with farmer A's steers). They hoped the sheep would do all right without affecting cattle weight gains. These sheep, cattle, and pastures were inferior, however, to the others.

McCloud and Alexander say the sheep definitely preferred the ladino clover, but steers showed little or no preference. In pastures that were stocked only with sheep, clover was grazed closely; because of light grazing, some of the orchardgrass developed seedheads.

The agronomists aren't sure why the combination-grazed pastures are in better shape after a season's use than the others. But they think one factor—shading by the lightly grazed orchardgrass—contributed to limiting clover production in the sheep-only pasture.

The researchers are conducting digestion trials, using sheep and cattle, to learn why the animals gained more weight when grazed together.★



Do steers need much

Fiber?



■ How much fiber does a fattening steer need in its ration to maintain good digestion and convert feed efficiently?

Apparently no more fiber than that in ground corn. And corn has about the smallest fiber content of any grain.

Ability of steers to thrive and gain efficiently on a very low fiber (all-concentrate) ration was demonstrated in feeding trials at USDA's Agricultural Research Center, Beltsville, Md. ARS animal nutritionist R. E. Davis conducted the study.

Steers fed a ration composed mostly of ground corn gained as much weight, graded as high when slaughtered, and converted feed more efficiently than steers fed a ration that included ground corncobs, which are high in fiber content.

Three groups of good grade feeder steers (nine animals per group) were self-fed all they wanted for 200 days in the test.

Group A was fed a ration containing 68 percent corn and cob meal, 20 percent ground corn, and 500 units of vitamin A per pound of feed. Each steer averaged 2.3 pounds of daily gain. *Group B* was fed ground corn (88 percent) and 500 units of vitamin A. Each animal gained 2.1 pounds a day. *Group C* gained 2.3 pounds a day on the 88 percent ground corn diet and 2,500 units of vitamin A. About 12 percent of all rations was soybean meal, bone meal, and mineralized salt.

Groups B and C (on all-concentrate rations) converted feed more efficiently into meat than the group given cobs. Steers in group C consumed only 6.6 pounds of feed per pound of gain. Group B animals ate 7.3 pounds of feed per pound of gain; group A, 8.5 pounds.

The nine steers in group A ate about a ton more ground corn (including the corn in the corn and cob meal) and about 800 pounds more of soybean meal than the nine animals in group C.

All gained about the same amount. Each weighed about 475 pounds when the trial began, and about 950 pounds when slaughtered. Twenty-five of the 27 animals graded choice. The other two graded good.

Davis says none of the steers had digestion trouble or bloat. This contradicts, as do results of several other all-concentrate trials, the long-held assumption that steers need roughage.

Vitamin A was increased 2,000 units in the ration of animals in group C to determine if it helped them to avoid stress and fatigue during summer months. Apparently it did.

Davis is trying to learn if the high vitamin A content boosted the feed efficiency of group C animals.★

Research and
extension provide
better living
in the . . .

Virgin Islands



■ A vest-pocket example of what a USDA research and extension team can accomplish is taking place in three of the U.S. Virgin Islands.

Some 600 farm families live better because of this 9-year effort in an area less than 140 miles square. Results include higher sugarcane yields and improved year-round fruits, along with better beef breeds and pastures to feed them. The future seems to hold more.

Other underdeveloped tropical areas can use developments and methods of the Virgin Islands Agricultural Research and Extension Program. British, Dutch, and French experiment stations in the area already exchange ideas and materials with the USDA workers.

A 58-acre research and extension center at Kingshill on St. Croix, largest of the three main Virgin Islands, is the

headquarters. Five research workers, three extension agents, and a farm work staff are employed at the ARS-supervised center.

There are numerous obstacles to productive farming and higher living standards on these islands:

- Only about half of the land is arable, and rough topography makes production difficult and uncertain. Island soils are nitrogen-poor.
- Rainfall averages a generous 45 inches annually, but is poorly distributed each year and varies widely from year to year. The evaporation rate is very high, and there is no water for irrigation.
- Food and feed are expensive; some must be imported. Tourism, a growing industry, has caused land values to rise. The per-acre price is \$500 and more.



Entomologist studies insect-feeding as a means of controlling cacti, which cause injury to livestock.

Researchers develop improved crops and farming methods, extension workers demonstrate benefits, on experimental plots.



Workers plant Pangola grass in 6-inch deep furrows. This South African import proved excellent for pasture on low-moisture Virgin Island soils.



Researchers showed yields of sugarcane, being harvested here in variety tests, doubled when crop was properly fertilized.

- Virgin Islanders are generally cautious about adopting changes in farming methods.

- Their diet is better than that of most tropical peoples but it still needs to be improved.

In spite of the obstacles, important progress has been made since the program started in 1952. For example, research findings that yields of sugarcane, chief crop in the islands, could be doubled by proper fertilization have been put to good use. And economic analysis has shown that proper application of fertilizers will raise per-acre gross value of the yields by about \$100 a year. Twenty-five percent more farmers now fertilize than in 1952.

New avocado varieties, adapted to local soils and climate, have been introduced and grown successfully and may become a valuable crop. Mangoes from Florida, Jamaica, and Vieques Island—imported to replace the worthless local wild mango—have done well in tests.

Swine and cattle breeding research may produce substantial benefits. Farmers are beginning to select cattle breeding stock on a productivity basis. And ARS scientists are trying to develop a meatier beef animal than the island breed, descendants from a cross between the British Red Poll and African Senegal. Efforts are being made to retain the island animal's good qualities. Artificial

insemination is being used to cross native stock with heat-tolerant U.S. beef and dairy breeds.

Scientists have shown that an acre of well-managed grass will produce 750 pounds of beef (two to three animals) a year. Cattle production is now second to sugarcane in economic importance.

Research on grasses that do well in shallow soils containing little moisture has proved that USDA-introduced Pangola is the best and most practical for pastures. Pangola grass is easily established, withstands grazing well, recovers rapidly, and is rather drought-tolerant. This sod grass is a very aggressive competitor of pasture weeds.

A survey of toxic plants was conducted to learn how many were a threat to the dairy industry. Surveys of insect and nematode pests have been made, and natural insect enemies of the sugarcane borer were imported in an effort to reduce losses.

Extension workers are making a special effort to reach young people to ensure progressive agriculture. A half-dozen 4-H clubs flourish. Radio broadcasts, news articles, and a newsletter are used to educate and induce families to change methods. Each year, the workers put on scores of demonstrations and make hundreds of visits to farms.☆



Untreated wool skirt (left) shrinks, has mussy texture after repeated wear and laundering in automatic washer. Treated skirt (right) keeps shape and smooth texture.

Progress in

Shrinkproofing Woolens

Easy-care uniforms, slacks, sweaters, and socks may result from use of USDA method

■ We're moving steadily ahead toward washable and shrink-resistant woolen garments.

Here's what has occurred since about a year ago, when USDA announced interfacial polymerization (IFP), a finishing treatment for imparting shrink-resistance to wool fabric:

1. Industry interest in IFP has been stimulated, and a number of textile manufacturers have begun commercial evaluation of the process.

2. Scientists of the ARS Western utilization division, Albany, Calif., are continuing efforts to improve this treatment, which they developed.

IFP is essentially a unique way to anchor minute quantities of resin on the tiny wool fibers. Only a fraction of an ounce of resin is needed to

treat a pair of slacks. The resin reduces the tendency of wool fibers to tangle and mesh ("felt") and to shrink during turbulent washing.

Several thousand yards of wool have been IFP-treated for industry and the Armed Forces for evaluation. Reaction has been enthusiastic for this treatment that holds the promise of easy-care slacks, sweaters, socks, and uniforms.

IFP was rated best by manufacturers

Generally, textile manufacturers have rated IFP the best such treatment yet developed. But the problems involved in turning a laboratory method into a low-cost, rapid, and efficient commercial process require extensive study.

Wool and Mohair Laboratory sci-

entists, headed by H. P. Lundgren, are continuing to refine IFP. This work suggests some new possibilities. For instance, their studies indicate mothproofing treatments can be combined with IFP. Various commercial mothproofing agents have been successfully incorporated with IFP. And some success has been gained in preliminary research to determine if woolen yarns can be IFP-treated before weaving.

At the same time, the researchers are accumulating information on the present fabric treatment, particularly as it relates to different kinds of weaves, by taking maximum advantage of wool's desirable characteristics. For example, studies are underway to evaluate the treatment on blends of coarse and fine wool fibers.

Basic research is included in studies

The broad program includes studies of the strength and mechanical behavior of treated fabrics, fiber fineness and fineness distribution, stability to high temperatures, and stress. Basic studies are underway on the binding of moisture by wool and on the molecular properties of wool proteins. All of this basic work is geared to helping develop new and better products and more economical processing.

In IFP, the reaction that creates the polyamide resin takes place on the fiber surfaces. First the fabric is dipped in a water solution of a diamine. After wringing, the fabric is dipped in a solution of an acid chloride. Then it goes through another wringing and through washing and softening steps.

Because the solutions of diamine and acid chloride do not mix (like oil and water), the resin-forming reaction takes place where the solutions make contact—at the interface. Therefore, the treatment is called interfacial polymerization.☆

GAINS FROM COOPERATIVE CITRUS SALES

■ Florida fresh citrus shippers can improve markets, better satisfy buyers' demands, and make the industry more stable by joining to sell their products.

One cooperative organization that would include most shippers would best meet current law requirements. Present shipping cooperatives and grower-shippers would have to make up 51 percent of the membership.

These conclusions were made by USDA's Farmer Cooperative Service after a study in Florida.

Fresh citrus sales have declined in the past 10 years, partly because of wider use of processed products. But increased production, buyers' specifying purchases by size and grade of fruit, and other changes in marketing have also added to shippers' selling difficulties.

When FCS agricultural economist F. E. Hulse made the study, he interviewed 120 representative shippers. One-third are affiliated with joint-sales groups.

Of the 120, 84 believe more joint sales of citrus are needed. Of those not united, 37 are willing to participate in some form of joint activity. But most of those questioned pointed to independence of other shippers as the main obstacle to working together.

If and when all shippers affiliate, they will be in a better position to bargain with buyers. They will more easily supply buyers with large volumes of specified sizes, grades, varieties, and containers of fruit. (Large-volume orders by chain store organizations are now the main purchases of citrus.)

Moreover, coordinated sales will help stabilize prices and the industry itself. There will be fewer price disruptions caused by shippers offering discounts to move fruit of off-size and less than top-quality. And a large sales organization could make more market contacts than individual shippers.☆

Putting Stretch in Cotton

■ Three methods for manufacturing all-cotton stretch yarns and fabrics have been developed by scientists of USDA's Southern utilization division, New Orleans, La.

Consumer demand for high-stretch fabrics is increasing rapidly. Imparting stretch to cotton can help increase consumption of it.

The three methods are: (1) slack mercerization of fabric to impart specific amounts of stretch; (2) back-twisting resin-treated yarns, which causes them to take the shape of tiny helical coil springs; and (3) crimping yarns first made thermoplastic by chemical treatment.

These developments result from a broad ARS effort to find new uses and new markets for cotton.

Slack mercerized fabric is already being evaluated by one company for use in plastic-coated automobile upholstery and interior linings. Others

are planning to evaluate the methods in making fabrics for knit bathing suits and dresses, hosiery, foundation garments, sweaters, knit shirts, and furniture slipcovers.

In the slack mercerization method, cotton fabric is allowed to shrink freely in a bath of sodium hydroxide solution. Amounts of shrinkage and stretch imparted are determined by the concentration and temperature of the solution and the density and weave of the fabric.

The second method involves treatment with resin-forming chemicals similar to those used in producing wash-and-wear fabrics. Cotton yarns treated with these resins tend, when stretched, to return to the shape they had when treated. The scientists applied this principle by first twisting yarn, then treating it with a resin such as dimethylol ethyleneurea, and finally reversing the twist. The back-twisted yarn tries to return to the highly twisted state in which it was treated. In doing so, the yarn pulls itself into tiny resilient helical coils that have as much as 200 percent stretch.

In the third method, cotton yarn is treated with a chemical, such as acetate anhydride, benzyl chloride, or acrylonitrile, that imparts thermoplastic characteristics to cotton. (Thermoplasticity is ability to become pliable when heated.) This yarn can then be permanently crimped or distorted mechanically in the presence of high temperatures. When tension is applied, the yarn lengthens as the crimp is pulled out. When the tension is removed, the relaxed yarn crimps again.

This process is similar to that used in making stretch yarns from thermoplastic synthetic fibers.☆

Cotton technologist J. J. Brown shows coworker Betty Short how the treated yarn stretches.





HOW SHORT FIBERS AFFECT COTTON

■ Processing difficulties mount as the short fiber content of cotton increases, USDA scientists have shown conclusively. Yarn uniformity, strength, appearance, and elongation decrease. Spinning efficiency and fabric quality are reduced.

These findings stem from a series of continuing investigations by cotton technologists L. A. Fiori and J. D. Tallant of the ARS Southern utilization division in New Orleans, La. They are trying to determine precisely what influences short fibers have on yarn and fabric properties and spinning performance.

Technologists know that two cottons of identical classer's length—average length of the long fibers—may

contain widely different amounts of short fibers. However, until recently there has been very limited information on short fibers. Researchers couldn't easily obtain cottons of different short fiber contents, and with all other properties approximately equal.

By means of a special technique—differential ginning—developed by ARS agricultural engineers, cottons with a wide range of short fiber content were obtained from one variety of hand-picked cotton. Fiori and Tallant found that in addition to decreases in spinning efficiency and yarn appearance, there was also a decided reduction in yarn strength—more than 1 percent for each 1 percent increase in short fiber content.

Cotton fibers longer than three-eighths inch apparently are long enough to be twisted into the yarn structure tightly enough to rupture rather than slip when the yarn is pulled to the breaking point, the cotton technologists learned. Fibers shorter than three-eighths inch not only slip and fail to contribute to yarn strength, but also appear to prevent the longer fibers from performing at maximum efficiency.

Since most yarns are used in fabric form, fabrics containing different percentages of short fibers were produced in the Southern division's pilot-scale textile mill. Some of each of the fabrics were sent to a commercial plant for finishing, including mercerizing and dyeing. When returned, all fabrics were tested.

As with the yarn, laboratory evaluation of the fabrics showed that short fibers were detrimental. Unfinished print cloth with 13 percent short fibers in the warp (length) and 8 percent in the filling (width) was 26 percent weaker, as measured by the Elmendorf tear test, than unfinished print cloth with 5 percent short fibers in both directions.

There were similar differences in strength between fabrics with high and low short fiber content at all stages of finishing.★

OVERDRYING PRODUCES SHORT FIBERS

■ Part of the difficulties in marketing U.S. cotton at home and abroad may start in the ginning operation.

If seed cotton is overdried by high temperatures during ginning, more fibers than usual break. Broken (short) fibers change length distribution which, in turn, causes breaks in yarn during spinning. These breaks must be repaired by hand, thus in-

creasing processing costs. And cloth made from this yarn isn't of the highest quality. Such factors reduce U.S. cotton's ability to compete with foreign cotton and domestic and foreign synthetic goods.

These findings were made by a USDA research team in the first of a series of broad investigations of cotton quality—and how production

and marketing processes affect quality.

Most ginners use artificial heat to dry damp, roughly harvested cotton, so that leaves, stems, and other trash picked up during harvest can be more readily removed. Removal of trash improves the grade of cotton.

In some gins, the moisture content of cotton may be reduced below the

recommended level for ginning—5 to 7 percent—so trash can be removed more easily.

Moreover, in some areas, a combination of high daytime temperatures and low relative humidity can reduce the moisture content of cotton below this percentage while it is still in the field. This occurs in Western irrigated areas and during some seasons in nonirrigated areas. Such cotton would need no further drying, but it might be sent automatically through artificial dryers as part of the ginning operation.

Moisture removal not harmful in itself

Ginning cotton below the recommended moisture level of 5 to 7 percent isn't so harmful in itself, the study showed; what matters is removing the moisture by artificial heat, and the degree of heat used.

The researchers compared effects of artificial drying that normally would have been done (at a temperature of 230° F. in the first drier and no artificial heat in the second drier) with: (1) drying at temperatures of 260° and 270° F. in the two driers, respectively; and (2) no artificial drying (the burners were turned off and temperatures in the driers dropped to 107° and 110° F. These temperatures were just a little above that of the outside air).

Drying at the higher temperatures removed the most moisture, and the number of short fibers increased along with the amount of moisture removed. Cotton that was dried without the use of artificial heat had the fewest short fibers.

High moisture cotton most affected

The study also indicated that as the *proportion* of moisture removed from cotton increases, so does the number of short fibers. A bale that has the highest moisture content to begin with, for instance, would be

most badly affected, even though its final moisture content is the same as other bales.

The scientists found that using lint cleaners (equipment that removes dirt and trash) on high-grade cotton doesn't necessarily bring highest returns to the grower.

Cotton treated by two lint cleaners improved in grade (from Middling to Middling Plus), but the weight removed was more than when lint cleaners weren't used. The higher price per pound paid for Middling Plus would be more than offset by the

money lost because of the cotton removed in cleaning. Weight was further reduced when additional moisture was removed by artificial drying at the higher temperatures.

Cotton used in this study was grown under irrigation in California. The research was conducted by agricultural economist J. E. Ross of the Economic Research Service, physicist C. G. Leonard of ARS, and cotton technologist E. H. Shanklin of the Agricultural Marketing Service. A commercial cotton ginning company cooperated.☆

Potassium in Northeast Pastures

■ Potassium fertilizer applied in early summer is effective in maintaining legume stands in Northeastern grass-legume pastures.

Legumes need a continuous supply of available potassium if they are to compete with vigorous pasture grasses. But maintenance of adequate levels of available potassium in soil is a major problem, particularly in the Northeast.

The problem is intensified by the tendency of pasture grasses to absorb potassium in excess of needs when it's readily available.

USDA soil scientists demonstrated how early summer applications of potassium markedly increase its content in pasture grasses late in the season. At this time, the level of available potassium normally is lowest. Early summer applications also produced marked responses the next spring, and there was a minimum of excess, or luxury, consumption of potassium by grasses.

One potassium fertilization per season may be inadequate in some situations—for example, where the growing season is longer, or rainfall more abundant, than during the tests. They were conducted at the U.S. Regional Pasture Research Laboratory, State College, Pa.

When more than one fertilization is needed, a substantial part of the potassium should be applied in summer.

Spring or fall fertilization accentuated the tendency of the forage to be high in potassium in spring and low in fall. Such applications increased potassium content of grass most in spring. Potassium depletion in fall was most acute in a favorable growing season. Then, potassium removal by forage was greatest.

Heavy applications of potassium every 2 to 3 years did not maintain adequate levels of the element for the plants.

ARS soil scientists R. R. Robinson, C. L. Rhykerd, and C. F. Gross cooperated with 12 State Agricultural Experiment Stations in the Northeast in the 6-year study. The soil was Hagerstown silt loam.☆

SHREDDED CORNSTALKS REDUCE EROSION



Immediately after corn picking, these stalks were shredded.

■ A between-crop mulch of shredded cornstalks may be the solution if erosion is a problem between corn harvest and seedbed preparation.

A mulch reduced erosion more than half in USDA-Purdue Agricultural Experiment Station tests. A flail-type shredder was used.

ARS soil scientist J. V. Mannering and agricultural engineer L. D. Meyer found that soil is protected best when shredding is done immediately after corn is picked.

Results of their experiments are particularly applicable in the Corn Belt, where as much as a fourth of the erosion from a corn-after-corn cropping system occurs between crops.

In the tests, rainfall was simulated with a portable sprayer that applied water equivalent to 2.4 inches of rain per hour. Test plots were on land with 3- to 4½-percent slope.

Mannering and Meyer compared three methods of handling stalks from corn that yielded 100 to 125 bushels per acre: shredded only, shredded and disked in, and standing stalks.

They found that disking shredded stalks was less effective than shredding alone. They concluded that disking shredded stalks can be justified only when an extreme soil blowing problem exists, or when additional moisture is needed in the soil profile.☆

GUIDE FOR SCHEDULING IRRIGATIONS



Disk taken from leaf of cotton plant is weighed, then allowed to take up water, and weighed again to gage plant's need for water.

■ Direct measurement of a plant's need for water would be an ideal way to determine when a crop should be irrigated. On the basis of preliminary tests, a USDA scientist thinks the relative turgidity method may be the way to make such a measurement.

This method compares water balance of the plant with the maximum water it is capable of taking up. ARS soil scientist L. M. Namken, Weslaco, Tex., tested the method on cotton and corn plants.

The relative turgidity method is based on the fact that plants needing water are in a condition known as plant moisture stress.

Namken takes leaf samples between 2 and 3 p.m., the time of maximum daily moisture stress. The samples are disks cut out of leaves with a leaf punch. He weighs the samples, places them on water until they become fully turgid, then weighs them again. The ratio of weights—the relative turgidity—is the measure of moisture stress of the plant.

Scientists now commonly attempt to interpret moisture stress from measurements or estimates of available soil moisture. Such interpretations are fairly reliable if data on which they are based are accurate, but the method involves daily recordkeeping and computations.

Field studies, in cooperation with the Texas Agricultural Experiment Station, have shown that the relative turgidity of cotton and corn plants is closely related to soil moisture and atmospheric conditions. Namken has found close correlation between plant moisture stress and conventional soil moisture measurements.

The method will be further tested in studies in which cotton irrigations are scheduled by measuring moisture stress.☆

Aid in screw-worm eradication

Future efforts to eradicate screw-worms may be easier because of a special colony of black screw-worm flies developed by USDA scientists at Kerrville, Tex. Screw-worm flies normally are blue-green.

The black color may be used as a genetic marker (distinguishable physical characteristic that is heritable) to identify sterilized flies after they are released for use in eradication. The sterilized flies would be released to mate with wild screw-worm flies and prevent reproduction.

A genetic marker is needed to eliminate a hindrance that arose during the successful 1958 campaign to eradicate this livestock pest in the Southeast. In that effort, vast numbers of male screw-worm flies were



sterilized by radiation and released. These flies mated with wild females, but the eggs did not hatch.

There was, however, no quick, effective way to identify the released flies, so entomologists could not easily determine progress in eradication. Irradiation does not alter appearance of the flies, and they are not radioactive. Dye or other markings are not permanent.

The first black fly was found by ARS insect geneticist L. E. LaChance in a laboratory colony originated in Florida. These flies had not been irradiated, so the black one is believed to have been a natural mutation. (A sex-linked recessive gene is involved.) Several generations of the fly have been produced.

Before black screw-worm flies can be considered for use in eradication, scientists must determine how the insects compare with wild screw-worm flies in mating activity, longevity, and flight range.

If the genetically marked screw-worm fly can be used successfully, the scientists have developed a valuable new research tool.

Associateships being offered

Research associateships are being offered promising young scientists who want advanced training by highly qualified veteran ARS scientists.

Twenty-five associateships, supported by USDA and the National Academy of Sciences-National Research Council, will enable recipients to study and do research for 1 year in an ARS laboratory. The awards will be announced about April 1, and the tenure of each may start after July 1.

Work will be done at Albany, Calif.; Beltsville, Md.; Lafayette, Ind.; New Orleans, La.; Peoria, Ill.; Plum Island, N.Y.; Philadelphia, Pa.; or Washington, D.C. Opportunities are in biochemistry, entomology,



genetics, microbiology, mineral nutrition of plants, physical chemistry, microbiological chemistry, plant physiology, and plant virology.

Applicants must produce evidence of training equivalent to that represented by the Ph. D or Sc. D degree and demonstrate superior ability for creative research. The stipend is \$8,995, subject to income tax.

Applications must be received at the Fellowship Office, National Academy of Sciences-National Research Council, 2101 Constitution Avenue NW., Washington 25, D.C., by February 1.

Changes in milk outlet use

Dairymen's outlets for milk have changed in the last 20 years—along with a shift from many small general farms to fewer but larger, specialized dairy farms.

Most milk produced now (84 percent in 1960) is sold as whole milk to plants and dealers. Only 43 percent was sold as whole milk in 1940. Sales of farm-separated cream to plants and dealers dropped from 30 percent in 1940 to 7 percent in 1960. Farmers' retail sales of milk went from 6 percent in 1940 to 1½ percent in 1960. On-the-farm use of



milk as food or feed decreased from 20 percent in 1940 to 7 percent in 1960.

One reason for these changes in use of outlets is that dairymen earn more by concentrating on production rather than on processing and retail sales, according to agricultural economist H. Bluestone of the Economic Research Service. Development of bulk handling methods, reducing the cost of moving whole milk, and better highways, making it easier to transport the milk, also helped produce the changes.

To increase production and lower unit costs, dairy farmers put more resources into larger herds and

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mechanized equipment. Moreover, as dairymen became fewer and more specialized, they were less able to use the skim milk separated from cream as feed for livestock.

At the same time, the nutritive value for humans of the solids in skim milk became more widely appreciated, and the price for skim milk increased rapidly. So farmers got better returns by selling whole milk to dealers or plants for processing.

More efficient pellet production

Producing coastal bermudagrass pellets that are competitive in price with alfalfa and other pellets may be possible if current research upholds preliminary findings.

These findings indicate that some minor changes in pelleting equipment may reduce production costs. Some of the changes include improving mechanisms for feeding grass into a pellet mill and redesigning the die that makes the pellets.

Materials for pelleting must be ground in a hammermill before being fed into a pellet mill. An important part of the initial research was determining the best size of grass particle to feed into a pellet mill.

Researchers found that grinding the grass through a $\frac{1}{4}$ -inch mesh screen made the best size particle for making a $\frac{3}{16}$ -inch diameter pellet, the one most commonly fed to livestock.

Limited pelleting of coastal bermudagrass is done. But the pellets

are expensive. Equipment cannot handle this nonlegume as efficiently as other materials. Production of coastal bermudagrass pellets is only about one-third that of alfalfa pellets made with the same equipment.

Feeding trials at Tifton, Ga., proved the value of coastal bermudagrass pellets. A pelleted ration in which most of the roughage was coastal bermudagrass produced greater weight gains in steers than an unpelleted ration of the same material.

This work was done cooperatively by ARS agricultural engineer J. L. Butler and agronomists and animal husbandmen of the Georgia Coastal Plain Experiment Station, Tifton.

New houseplan for small family

Alternate plans for a new one-story, two-bedroom house suitable for a young family or elderly couple have been developed by USDA agricultural engineers and housing specialists.

One Plan (No. 7160) is for construction on a concrete slab. This house provides 1,170 square feet of

living area. The other ARS plan (No. 7159) allows for a basement where bedrooms, a utility room, closets, and a second bathroom can be built.

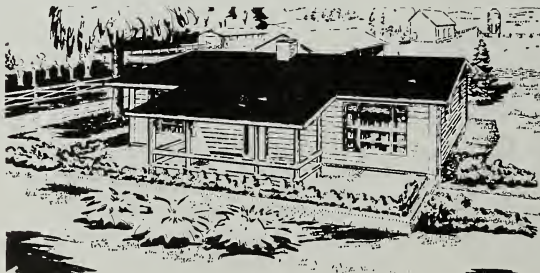
The front entrance, protected by a roof over part of a brick terrace, leads through an entry-alcove with a coat closet into the living room.

The rear entrance opens into a work area. A combined kitchen and dining area is separated from the work area, which has space for a washer, drier, freezer, small sink, and closet. The water heater and central heating unit are in a utility room near the center of the house. Each of the bedrooms has two closets.

The front yard can be landscaped to form a living area, with border plantings at the terrace to blend the house with its surroundings.

An engineer or contractor should determine if the site is suitable for slab-on-grade construction.

Working drawings, distributed through the Cooperative Farm Building Plan Exchange, may be obtained from the Extension agricultural engineer at most State agricultural colleges. There is usually a small charge.



House can be built on concrete slab or over a basement that may be used for bedrooms, closets, utility room, and bath.